

Amendment Pursuant to 37 CFR 1.116

Claims

1.-11. (Canceled)

12. (Previously presented) A single use endoscope that is removably connectable to a reusable control unit to form a system for examining an internal body cavity of a patient, comprising:

- a shaft having a proximal end, a distal end and a number of lumens therein;
- an articulation joint at or adjacent the distal end;
- an imaging assembly at or adjacent the distal end of the shaft to produce images of the internal body cavity, the imaging assembly including:
 - a hollow cylindrical cap having a cavity therein and a front face through which illumination light passes and an imaging port; and
 - a heat exchanger assembly received within the cavity of the cap, the heat exchanger including:
 - a cooling channel having an inlet and an outlet in which a cooling material is passed and a recess;
 - one or more light emitting diodes mounted on a circuit board that is in thermal contact with the cooling channel; and
 - a lens assembly that is positioned in the recess of the cooling channel to be aligned between the imaging port and a solid state imaging device secured to the heat exchanger assembly.

13. (Previously presented) The single use endoscope of Claim 12, wherein the heat exchanger includes two light emitting diodes and the cap of the imaging assembly includes two illumination ports aligned with the two light emitting diodes.

14. (Previously presented) The single use endoscope of Claim 12, wherein the recess of the heat exchanger has a diameter that mates with an outer diameter of the lens assembly in order to retain the lens assembly in the heat exchanger and align it with the imaging device.

15. (Previously presented) The single use endoscope of Claim 13, wherein the illumination ports include a window that is coated with a phosphor.

16. (Original) The single use endoscope of Claim 15, wherein the phosphor is applied to an inside surface of the illumination port windows with an adhesive.

17. (Original) The single use endoscope of Claim 15, wherein the image assembly includes a cable having at least two shielded leads for transmitting image signals from the solid state imaging device differentially.

18.-31. (Canceled)

32. (Previously presented) An imaging system for use with an endoscope, comprising:
a cap having a hollow internal cavity with a front face through which illumination light passes;
a heat exchanger that is fitted within the internal cavity of the cap, the heat exchanger including:

one or more light emitting diodes mounted on a circuit board;

an image sensor;

a cooling channel having an open face that is sealed by the circuit board such that a cooling material within the cooling channel is in thermal contact with the one or more light emitting diodes; and

a recess into which a lens assembly is fitted and aligned with the image sensor.

33. (Previously presented) The image system of Claim 32, wherein the front face of the cap has windows therein that are aligned with the one or more light emitting diodes.

34. (Original) The imaging system of Claim 33, wherein the windows have a phosphor coating on an inside surface thereof.

35. (Original) The imaging system of Claim 34, wherein the phosphor coating is mixed with an epoxy.

36. (Original) The imaging system of Claim 35, wherein the epoxy is curable with an ultraviolet light shown through the windows of the cap.

37. (Previously presented) The imaging system of Claim 32, wherein the cap has a flushing port molded into the front face of the cap that directs a flushing liquid over the cap in front of the lens assembly.

38.-55. (Canceled)

56. (Previously presented) The single use endoscope of Claim 12, wherein the cooling channel includes a lip that extends around a periphery of the cooling channel and against which the circuit board is seated in the cooling channel of the heat exchanger.

57. (Previously presented) The single use endoscope of Claim 12, wherein the heat exchanger includes a thermistor that produces a signal proportional to the heat of the distal end of the endoscope.

58. (Canceled)

59. (Previously presented) The imaging system of Claim 32, wherein the recess in which the lens assembly is fitted is generally circular and the cooling channel is generally semicircular in shape and is positioned around the perimeter of the recess.

60. (Previously presented) The imaging system of Claim 32, wherein the heat exchanger includes a thermistor that produces a signal that is indicative of the heat of a distal end of the endoscope.

61. (Currently amended) An endoscope comprising:

a flexible shaft having a proximal end and a distal end and a working channel lumen therein;

a hollow cap having an internal cavity on the distal end of the shaft including a front face with an opening to the working channel of the endoscope;

a heat exchanger that is fitted within the internal cavity of the cap, the heat exchanger including:

a cooling channel through which a cooling liquid passes;

a circuit board having one surface that contacts the cooling liquid in the cooling channel and another surface on which one or more light emitting diodes are mounted, wherein the heat exchanger includes a recess into which a lens assembly is fitted and aligned with an image sensor and wherein the image sensor is secured to the heat exchanger in line with the lens assembly.

62. (Canceled)

63. (Canceled)

64. (Previously presented) The endoscope of Claim 61, wherein the heat exchanger includes a temperature sensor that produces signals indicative of the temperature at the distal end of the endoscope.

65. (Currently amended) An endoscope comprising:

a shaft having a proximal end, a distal end and a working channel;

a cap having an internal cavity and a front face positioned at the distal end of the shaft;

an insert that is fitted within the internal cavity of the cap and behind the front face, that includes:

an illumination source;

a heat exchanger that supports the illumination source, the heat exchanger including a cooling channel in which a liquid is passed and is warmed by heat from the illumination source, wherein the heat exchanger includes a recess into which a lens assembly is fitted and aligned with the image sensor and wherein the illumination source is mounted on a circuit board having a surface that

contacts the liquid within the cooling channel.

66. (Canceled)

67. (Canceled)

68. (Previously presented) The endoscope of Claim 65, wherein the heat exchanger further includes a thermistor that produces a signal indicative of the heat of the distal tip of the endoscope.

69. (Previously presented) An endoscope comprising:

a shaft;

a cap at an end of the shaft;

an insert that is fitted within the cap, the insert including:

one or more illumination sources that generate heat when producing illumination light;

a heat exchanger including a cooling channel having an inlet and an outlet through which a fluid is passed to remove heat from the end of the shaft;

an image sensor that is supported by the heat exchanger between the inlet and outlet of the heat exchanger; and

a lens assembly that focuses light onto the image sensor,

wherein the cooling channel of the heat exchanger has a curved shape that forms a recess in the heat exchanger in which the lens assembly is positioned to focus light onto the image sensor.

70. (Previously presented) An endoscope comprising:

a shaft having a proximal end, a distal end, and at least one working channel therein;

a hollow cap having a front face at the distal end of the shaft through which illumination light passes; and

a heat exchanger positioned behind the front face of the cap and having an inlet and an outlet and a cooling channel therebetween through which a cooling material is passed, the cooling channel including a circuit board constructed and arranged to have a first surface that contacts the cooling material and a second surface on which one or more LEDs are mounted.

71. (Previously presented) The endoscope of Claim 70, wherein the hollow cap includes a semicircular cavity and wherein the cooling channel has a semicircular outer surface that fits within the semicircular cavity of the cap.

72. (Previously presented) The endoscope of Claim 71, wherein the heat exchanger includes an image sensor mounted to the heat exchanger behind the cooling channel and a lens assembly, wherein the cooling channel includes a cylindrical recess in which a lens assembly is positioned and aligned with the image sensor.

73. (Previously presented) The endoscope of Claim 71, wherein the heat exchanger includes a pair of proximally extending legs having lumens therein that are fluidly coupled to the inlet and outlet of the cooling channel.

74. (Previously presented) The endoscope of Claim 73, wherein the image sensor is mounted to the heat exchanger between the pair of proximally extending legs and in line with the cylindrical recess.

75. (Previously presented) The endoscope of Claim 70, wherein the hollow cap includes an opening to the working channel of the shaft.

76. (Previously presented) An imaging assembly for an endoscope, comprising:
a hollow cap having a front face, an opening to a working channel within the front face, and a semicircular cavity behind the front face; and
a heat exchanger having a semicircular shape that fits in the semicircular cavity of the cap, the heat exchanger including a semicircular cooling channel that extends around a cylindrical recess having a diameter that mates with a lens assembly fitted within the cylindrical recess.